REPORT OF THE COMMITTEE

ON THE

CONDITION OF THE WATER SUPPLY

FOR THE

CITY OF CONCORD.

APPOINTED MAY 28, 1880.

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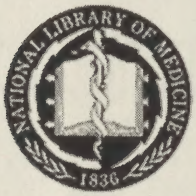

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BOARD OF WATER COMMISSIONERS.

HORACE A. BROWN, Mayor, *ex-officio.*

JOHN KIMBALL,	WILLIAM M. CHASE,
JAMES R. HILL,	JAMES L. MASON,
SAMUEL S. KIMBALL,	LUTHER P. DURGIN.

OFFICERS.

JOHN KIMBALL, *President.*
WILLIAM M. CHASE, *Clerk.*
CHARLES C. LUND, *Engineer.*
V. C. HASTINGS, *Superintendent.*

At a meeting of the Board of Water Commissioners, held at their office May 28, 1880,—

Voted, That hose shall not be used for sprinkling pavements and grounds and washing windows, from seven o'clock in the morning to six o'clock in the evening of each day, without special permission of this Board first had and obtained.

Voted, That the President, Superintendent, and Engineer of this Board be a committee to investigate the practicability of obtaining water from Little Pond for use in the higher portions of the city, and the cost thereof; also, to investigate all other plans for supplying water consumers on the higher lands of the city, with the cost and feasibility of each plan, and obtain such other information as may be useful to enable this Board to act intelligently in the premises.

REPORT.

To the Board of Water Commissioners for the City of Concord:

GENTLEMEN: The committee appointed to make an examination, and report upon the condition of the water supply for the city of Concord, beg leave to submit the following report:

That they find that difficulty is experienced in some of the more elevated parts of the city in obtaining an adequate supply of water, and that said difficulty has increased from year to year as the consumption of water has increased.

That said difficulty is not caused by reason of any scarcity of water in the pond, there being at the present time between ten and eleven feet of water over the pipe which supplies the city, and that the water is now up within two feet of the high-water line to which the Messrs. Holden could hold the pond by their dam when the Water-works were begun.

That said difficulty arises from the fact that at certain hours of the day, when the largest amount of water is being used, so much water is being drawn upon the lower ground that the head is so reduced that it will not flow up to the houses on the hill.

For the purpose of demonstrating this fact, your committee caused the water-pressure gauge in the office of the Water Board to be watched continuously for one week, beginning June 13 and ending June 19, and obtained the

average pressure for each hour during that period, and have prepared the accompanying profile, which indicates the rate of flow of the water during each hour.

These observations were made very soon after the vote of the board was promulgated which limited the use of hose. If it had been made before that order, no doubt the hourly averages obtained would have been considerably larger. These observations further indicated that the largest consumption of water is generally between the hours of 7 and 11 o'clock in the forenoon; and that from 9 o'clock in the evening till 4 o'clock in the morning, the least water is used, and generally during that period there would be no difficulty in obtaining water at any point in the system within two feet of the level of the water in Long Pond.

The height of the water in the pond was 177 feet above the datum-line of levels.

The summits of some of the hills on the streets leading west from Main street are as follows:

Pleasant street, ...	122 feet.
Warren "	121
School "	142
Centre "	133
Franklin "	124
Church "	140

So that, with the present stage of water in Long Pond, the head of water on said summits would be as follows:

Pleasant street, ...	55 feet.
Warren "	56
School "	35
Centre "	44
Franklin "	53
Church "	37

In the hours of the day when the most water was being drawn during the week covered by our experiment, we found that water must have been flowing through our main pipe *at the rate of* 1,282,920 gallons per day. That was the

average rate of flow for one hour on Tuesday, between 1 and 2 o'clock P. M., and the entire amount of water consumed that day was 771,205 gallons. So, that for the hour of largest draft, we drew at nearly double the average rate for the entire day.

Now, if it were required to deliver 1,282,920 gallons here in twenty-four hours, at an even rate of flow, it would require 22.21 feet of head to deliver it here; so that on the summit of School street hill, there remains only 12.79 feet available head,—a head hardly sufficient to deliver water into the basement of some of the dwellings in that vicinity. And since the order limiting the use of hose, and since the above observations were made, there have been periods in the day when residents there could not draw water in the lowest faucets in their cellars. Before the order they were in that dilemma for a considerable part of the day when they required the most water for domestic purposes. If a fire had then broken out in that vicinity, it is doubtful if the hydrants would have yielded water for the use of the engines. It follows, therefore, that when the time arrives when the city consumes its quota of one million gallons per day, there will be hours in the day when we shall be drawing at nearly double that rate; and if we are dependent on our present pipe to bring it here, we shall experience a loss of head of 57.68 feet, and the area where the residents could not obtain water during the hours of largest draft, for either domestic or fire purposes, would be very largely increased.

Our water pipe, therefore, is too small to deliver that amount of water and keep up sufficient head to supply the highest parts of the compact portion of the city.

We now propose to discuss the remedy or remedies for this state of things.

1. And the first remedy is a more rigid economy in the use of water.

Our city has purchased the right to take from Long Pond one million gallons of water per day, on an average, or three hundred sixty-five millions of gallons per year. This quantity will supply 50 gallons per day each for 20,000 people.

We estimate that about 7,000 people are depending on Long Pond water. It may not be amiss here to give a statement of the quantity per day, per individual, used in various cities, and we take the following from the remarks recently made by the Hon. E. H. Rollins, in a discussion in the U. S. Senate in regard to the use of water in the city of Washington, because he has collected the statistics ready for our use.

Providence	uses	25 gallons.
Fall River	"	26 "
Lowell	"	33 "
Lynn	"	34 "
Rochester	"	35 "
Columbus	"	43 "
Lawrence	"	44 "
Milwaukee	"	53 "
Cambridge	"	55 "
St. Louis	"	56 "
Cleveland	"	56 "
Cincinnati	"	57 "
Philadelphia	"	58 "
Brooklyn	"	63 "
Montreal	"	69 "
Boston	"	75 "
Toronto	"	77 "
Buffalo	"	87 "
Detroit	"	105 "
Chicago	"	119 "
New York	"	100 "
Albany	"	80 "
Jersey City	"	99 "
London, England,	uses	29 "
Liverpool,	"	23 "
Glasgow, Scotland,	"	50 "
Edinburgh,	"	38 "

Dublin, Ireland,	uses	25 gallons.
Paris, France,	"	28 "
Torres, "	"	22 "
Toulouse, "	"	26 "
Lyons, "	"	20 "
Leghorn, Italy,	"	30 "
Berlin, Prussia,	"	20 "
Hamburgh, "	"	33 "

An average in these thirty-five cities of 48 gallons per capita, very nearly; and this, it should be understood, includes its use for all purposes,—domestic, mechanical, and fire,—and includes the supplies for tanneries, steam-boilers, public watering-troughs, and fountains, and the various other industries appertaining to the several cities.

During the week of our observations above mentioned, we used on

Sunday,	297,020 gallons.
Monday,	501,645 "
Tuesday,	771,205 "
Wednesday,	753,046 "
Thursday,	673,057 "
Friday,	705,078 "
Saturday,	625,880 "
Total,	4,326,931 "
Average per day,	618,133 "

This average rate would be 50 gallons per day for 12,362 people, nearly equal to the population of the whole city.

The largest day's draft, 771,205 gallons, would give 50 gallons per day for 15,424 people, a number larger than the recent census shows our population to be in the whole city; so that we are using very nearly 100 gallons per capita per day for the population dependent on Long Pond water, or double the average quantity used per capita in the thirty-five cities above mentioned.

Such an excessive draft per capita was not contemplated when the Water-works were constructed. But it was con-

sidered that an allowance of 50 gallons per day per capita would be ample, as it really is; and that such excessive draft as we are now making would not happen till at least 14,000 people were using the water, when it was considered that a distributing reservoir might be necessary to equalize the supply. If we did not consume more than 50 gallons per day per capita now, no difficulty would be experienced in obtaining water on School street hill.

But we are here met with the suggestion, that we have paid for a million gallons per day, and we want to use water freely within that limit. That is very true. But the Water-works were constructed,—as other water-works are,—upon certain calculations as to population and rates per capita, and it was not considered, and it is very doubtful whether those who had the work in charge ought to have considered, that the water was to be used for water motors, and the wholesale irrigation of lawns, gardens, and fields even, in the lavish and profuse manner in which our people have grown accustomed to use it. The liberal use of water as a sanitary measure is not to be condemned, and it is desirable that the supply should be ample. Everybody has had the idea that we were not drawing as much water as we had paid for, and therefore nobody had a right to complain of its use in any way. But our system was not designed for that, but was designed to be sufficient until 20,000 population should need to be supplied by it at an average rate of 50 gallons per day.

If self-closing faucets were put on all the service-pipes, we have no doubt it would do much to bring the use of water within reasonable limits.

2. The cutting-off of a part of the elevated portion of the city from the present system, and creating a high-service district, to be supplied from some other source than through one Long Pond main.

It has been suggested that a high-service district might be supplied by laying a pipe to Little Pond. The elevation

of Little Pond is 480 feet above the river, so that abundant head could be had for any purpose. But your committee, after considering that subject, and visiting and examining Little Pond, came to the conclusion that the people of Concord would hardly be satisfied with Little Pond water unless the entire basin of the pond should be thoroughly cleaned out, and cleared of vegetable matter,—an undertaking involving a very large expense,—and that the volume of water which could be relied on from that source would not be sufficient to justify the expense.

The construction of a reservoir to supply the high-service district, to be filled by pumping, has been suggested. But with our present draft of water we cannot spare any from our main to be pumped into a high-service reservoir; and if that plan should be adopted, it would involve the laying a main from Long Pond to the pumping-station, that being the only satisfactory source of supply.

3. The third remedy will be to lay another main to Long Pond.

Basing our calculation upon the use of one million gallons per day, it will involve a loss of head of 14.42 feet, provided the water comes with an even flow for the twenty-four hours. During the hours when the draft will be at the rate of two millions of gallons, the loss of head will be 57.68 feet. But if we have two 14-inch pipes, it will involve a loss of head of only 3.6 feet to deliver at the rate of one million gallons per day, and 14.4 feet to deliver at the rate of two million gallons per day; and with this state of things, no difficulty will ever be experienced on School street hill.

The cost of such a new main to Long Pond would probably be about the same as the cost of the old one, if laid of the same material,—$3.13 per foot, or $56,340 for the main; and the cost of making sufficient and suitable connections with the present system would bring the total up to $60,000. If a cast-iron main pipe should be used instead of the

cement pipe, it could be laid for about the same price. But we have not figured on all the details of such a work with its various connections, but give the above as an approximate estimate of the cost.

This plan, if it should be adopted, would keep up a better head of water under our draft than we should be likely to obtain from a reservoir.

4. The fourth expedient will be to construct a reservoir at some convenient point near where Washington, Centre, and School streets concentrate, at such an elevation that Long Pond water will flow into it through the present system of pipes, to the end that it shall fill in the night-time and in times of small draft of water, and be ready to be used in times of larger draft.

We have remarked before, that our main pipe was too small to deliver at the rate of one million gallons per day, and keep up a sufficient head to supply the more elevated parts of the city; and this is because of the great loss of head caused by friction of the water through the long main.

The distance from the State House to Long Pond may be taken at 6000 yards, and we assume that to be substantially the centre of gravity of the water system. From the State House to the site of the proposed reservoir is about 1200 yards; and a 14-inch pipe, or its equivalent, 1200 yards long, will deliver a given amount of water per minute or per day, with a loss of one fifth the head required for the same pipe 6000 yards long.

If, then, we lose 22.21 feet head on our Long Pond main, we should lose only 1-5 of that head if our source of supply were only 1200 yards off. (1-5 of 22.2=4.44 feet, very nearly.) And in this case we could maintain a pressure which would cause the water to flow within five feet of the level of the water in the reservoir, when we are drawing at a maximum rate of 1,282,920 gallons per day. The reservoir then would act as an equalizer, or kind of balance-wheel, storing water in times of small draft to deliver to

us in times of large draft, with but little loss by friction because of its proximity to the place where the water is to be used.

Such a reservoir, in our opinion, should be constructed large enough to contain at least ten days' supply for the city at the lowest stage of water in the pond. At the average stage of water in the pond it should contain twenty days' supply; so that, in case any accident should happen to our main pipe, we should have an adequate supply of water to fall back upon while repairs could be made. At the present time we are so dependent on Long Pond that an accident to our main, which would require a week or ten days to repair, would involve very serious consequences as to the interruption of our domestic supplies, and might, too, involve very disastrous consequences in case of fire. We have estimated the cost of such a reservoir, of such size that it would contain one million gallons, or a day's supply for each foot in depth, and find it would involve about 80,000 cubic yards of excavation and embankment, which, in the situation proposed, would cost

50 cents per yard, ...	$40,000
The cost of the gate-house, and outlet and inlet pipes, we estimate	3,000
The cost of making connection with the present system, we estimate	5,000

This reservoir would contain 30,000,000 gallons of water when full; but it could be filled only when the water in Long Pond was up to the high-water mark in that pond—an event which happens very seldom, and has occurred only once since the Long Pond dam was built.

Taking the land damages and contingent expenses into account, we think the construction of such a reservoir would cost $60,000.

We have thus presented the facts which seem to us proper to be borne in mind in determining what to do.

The first remedy suggested is the cheapest, and to apply it our people must either voluntarily deny themselves, or the more disagreeable method of compelling them to use less water must be resorted to. If meters were placed on every supply-pipe, and people compelled to pay for the water they use at meter rates, they would be more careful. But the expense of applying meters to every service-pipe would amount to $20 each, or about $40,000 for the whole, which would have to be paid either by the individual consumers, or by the city.

The second remedy we lay out of the question for the present.

The third and fourth remedies will entail an additional expenditure for our Water-works of say $60,000, whichever may be adopted ; and we leave it to you, assisted by the advice and counsel of the city government, and of the citizens and tax-payers generally, to determine what is to be done.

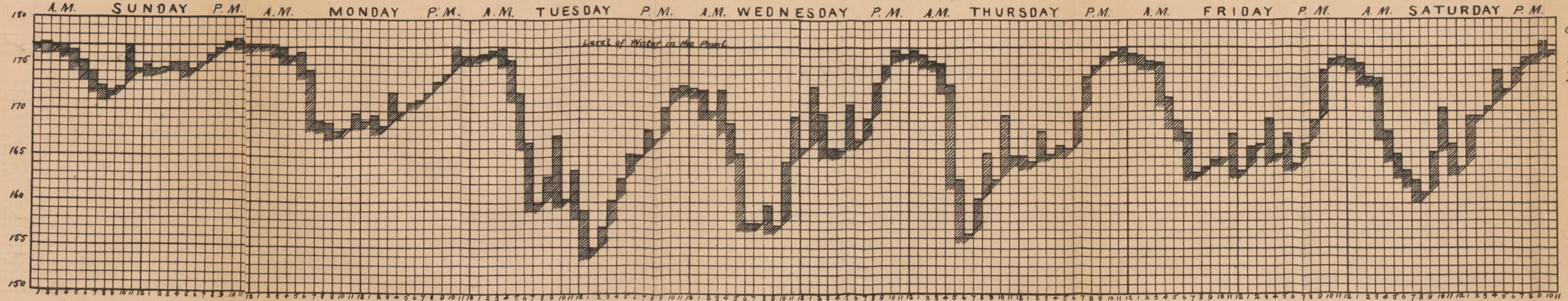
We may add, however, that we believe an untaxable bond of the city of Concord, in small amounts, can be sold, bearing interest at 4 per cent.

The recent change in rates, by which families of more than two persons pay one dollar less, and families of two and under pay two dollars less, than they did under the rates first established, in the first instance reduced the income from the water rates about $2,400. A restoration of the old rates would meet the interest of the above expenditure of $60,000.

Respectfully submitted,

JOHN KIMBALL,
V. C. HASTINGS,
CHAS. C. LUND,
Committee.

Diagram Showing Loss of Head and Rate of Flow of Water in Concord, N. H., June 13 to June 19, inclusive.



EXPLANATION.

The vertical lines represent hours of the day. The horizontal lines represent feet in height. The distance in feet between the horizontal line marked "Level of Water in the Pond" and the shaded line represents the loss of head in feet required to deliver water here as fast as required. The figures at the right show the hourly flow corresponding to the loss of head opposite.